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ABSTRACT

This manual describes the screening procedures used to identify infants and children in need of further diagnosis and treatment for hearing loss in Minnesota. It is intended for use by Community Health Service agencies, school health programs, Head Start agencies, and voluntary agencies, and should be used as a post-training reference. Newborn hearing screening is briefly described. The bulk of the manual is devoted to the description of screening procedures for older infants and children. Section 1 presents procedures for infants and toddlers up to 3 years, including risk factors, hearing history, checklist of auditory and communication development, external inspection and otoscopy, and tympanometry. Section 2 discusses procedures for 3- to 5-year-olds, including hearing history, external inspection and otoscopy, tympanometry, pure tone screening, pure tone threshold screening, and play audiometry. Section 3 presents information on screening for school age children, including parent/teacher/child observation, external inspection and otoscopy, tympanometry, pure tone screening, pure tone threshold screening, and play audiometry. Appendices include a glossary, recommended screening frequency, environmental noise level check, check sheets for mechanical function and biologic calibration, and forms used in hearing screening programs. (KDFB)

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HEARING SCREENING PROCEDURES

FOR

INFANTS and TODDLERS, EARLY CHILDHOOD & SCHOOL AGE CHILDREN

FEBRUARY 1996

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Minnesota Department of Health
Hearing and Vision Conservation Program
DIVISION of FAMILY HEALTH
717 Delaware Street S.E., P.O. Box 9441
Minneapolis, Minnesota 55440

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Educational Audiologists:

Dan Kallaus
South Central Service Cooperative

Linda Kalweit
North East Service Cooperative

Janet Lindeman
Sherburne and Northern Wright
Special Education Coop

Pat Rice
Minnesota Academy for the Deaf/HH

Cindy Wetzell
Educational Audiology
Anoka-Hennepin Learning Center

Professional Review Committee:

Dr. Robert Smith
Otolaryngology
Otolaryngology & Head and Neck Surgery P.A.
Central Medical

Dr. James McCord
Pediatrics, St. Paul Children's Hospital

Dr. William Maus
Family Practice
Crossroads Clinic, Chanhassen

Delphi Sorenson
School Nursing
Robbinsdale Public Schools

Cindy Wetzell
Educational Audiology
Hennepin-Anoka Learning Center

Ann Napp
Academy of Audiology
Audiology Associates

Pam Schultz
Public Health Nursing
Carver County Health Service

Amy McQuaid
Department of Human Services
Deaf and Hard of Hearing Services Division

Mary Bakken
Department of Education
Minnesota Academy for the Deaf

Upon request, this information can be made available in alternative formats, such as large print, braille or audio tape.

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INTRODUCTION TO HEARING SCREENING MANUAL

Hearing screening conducted by properly trained personnel will lead to early identification of children with hearing loss. The screening process can identify children with outer and middle ear problems as well as hearing loss caused by damage to the inner ear. The screening program described in this manual is intended to identify children in need of further diagnosis and treatment. The Minnesota Department of Health recommends that the local screening agency, in cooperation with area educational audiologists, and/or teachers of the deaf/hard of hearing, develop a protocol for follow-up of all children referred. This should include a follow-up screening audiogram 3 months after the referral.

This manual is intended to be used by Community Health Service agencies, school health programs, Headstart agencies and voluntary agencies to assure quality hearing screening. This manual incorporates the information contained in the former hearing screening, tympanometry and infant and toddler hearing screening manuals. These hearing screening guidelines serve as the basis of hearing screening for school programs, Early Childhood Screening (ECS), and Child and Teen Check-Ups (C&TC). C&TC is known in other states as Early Periodic Screening Diagnosis and Treatment (EPSDT). Hearing screening is mandated for C&TC programs by M§ 2568.04-256B.0625 and for Early Childhood Screening by M§ 123.701-123.702.

<u>The manual is not a substitute for training</u> but should be used as a post-training reference. Detailed descriptions of each procedure will be presented at the training workshops.

NEWBORN HEARING SCREENING

It is imperative that hearing loss be identified as early as possible. Early input of sound through amplification and language stimulation has been found to be beneficial to deaf and hard-of-hearing children. Lack of early auditory input may result in significant problems both educationally and socially.

The procedures that are recommended for infant hearing screening in Minnesota are described in this manual. These include:

1. **High Risk factors (pages 3 and 4)**
2. **Hearing History (page 5)**
3. **Checklist of auditory and Communication Development (pages 6 and 7) and**
4. **External Inspection and Otoscopy (page 8)**

Parent Information (page 32) is not a screening procedure. It is designed as a handout to be duplicated, discussed with the parent/caregiver and then given to them for their use. This handout will aid the parent in reporting the hearing history on future visits.

Advances in technology, which did not previously exist or initially proved too costly, now provide opportunities for screening large numbers of newborns in many hospitals. These include the use of: otoacoustic emission testing (OAE) and automated auditory brainstem response (ABR). While OAE and ABR testing have not been addressed in this manual, the Minnesota Department of Health encourages the use of these techniques to screen newborns and supports expansion of audiologist supervised newborn screening in Minnesota. It is important that as this screening becomes increasingly available, adequate systems of tracking, treatment and follow-up be developed.

SCREENING PROCEDURES FOR

INFANTS
and
TODDLERS

Birth to 3 Years

- RISK FACTORS
- HEARING HISTORY
- CHECKLIST OF AUDITORY AND COMMUNICATION DEVELOPMENT
- EXTERNAL INSPECTION & OTOSCOPY
- TYMPANOMETRY

SCREENING PROCEDURES

RISK FACTORS*

Ages/Grades: Birth through 28 days (usually conducted by a physician).
29 days to 3 years (ususally conducted by trained nurses and other health professionals).

Purpose: To determine if factors exist that put the child at risk for hearing loss.

Description: A review of the birth and other medical records for risk factors.

Equipment: None.

Facilities: Comfortable area.

Procedure: Check birth and other medical records against the age appropriate risk factors.

WNL: No risk factors identified.

Rescreen/Refer: Any child with one or more risk factors should be evaluated for possible hearing loss.

FOR USE WITH NEONATES (BIRTH THROUGH 28 DAYS)
WHEN UNIVERSAL HEARING SCREENING IS NOT AVAILABLE

1. Family history of congenital or delayed onset of childhood sensorineural impairment.
2. In utero infection, such as cytomegalovirus, rubella, syphilis, herpes, and toxoplasmosis.
3. Craniofacial anomalies including those with morphological abnormalities of the pinna and ear canal.
4. Birth weight less than 1,500 grams (3.3 pounds).
5. Hyperbilirubinemia at a serum level requiring exchange transfusion.
6. Ototoxic medications including but not limited to the aminoglycosides used in multiple courses or in combination with loop diuretics.
7. Bacterial meningitis.
8. Apgar scores of 0-4 at 1 minute or 0-6 at 5 minutes.
9. Mechanical ventilation lasting 5 days or longer.
10. Stigmata or other findings associated with a syndrome known to include sensorineural hearing loss and/or conductive hearing loss.

FOR USE WITH INFANTS (AGE 29 DAYS THROUGH 2 YEARS) WHEN CERTAIN HEALTH CONDITIONS DEVELOP THAT REQUIRE RESCREENING

1. Parent/caregiver concern regarding hearing, speech, language and/or developmental delay.

2. Bacterial meningitis and other infections associated with sensorineural hearing loss.

3. Head trauma associated with loss of consciousness or skull fracture.

4. Stigmata or other findings associated with a syndrome known to include a sensorineural hearing loss and/or conductive hearing loss.

5. Ototoxic medications, including but not limited to chemotherapeutic agents or aminoglycosides, used in multiple courses or in combination with loop diuretics.

6. Recurrent or persistent otitis media with effusion for at least three months.

FOR USE WITH INFANTS (AGE 29 DAYS THROUGH THREE YEARS) WHO REQUIRE PERIODIC MONITORING OF HEARING

Some newborns and infants may pass initial hearing screening but require periodic monitoring of hearing to detect delayed-onset sensorineural and/or conductive hearing loss. (Infants with these indicators require hearing evaluation at least every six months until age three years, and at appropriate intervals thereafter).

Indicators associated with delayed-onset sensorineural hearing loss include:

1. Family history of hereditary childhood hearing loss.
2. In utero infection, such as cytomegalovirus, rubella, syphilis, herpes, or toxoplasmosis.
3. Neurofibromatosis Type II and Neurodegenerative disorders.

Indicators associated with conductive hearing loss include:

1. Recurrent or persistent otitis media with effusion.
2. Anatomic deformities and other disorders that affect eustachian tube function.
3. Neurodegenerative disorders.

* The Joint Committee on Infant Hearing Screening, 1994 (of the American Speech-Language-Hearing Association, the Academy of Pediatrics, and the Academy of Otolaryngology).

The Minnesota Department of Health recommends that children with one or more risk factors should be evaluated for possible hearing loss.

SCREENING PROCEDURES

HEARING HISTORY

Ages/Grades: Birth to 3 years.

Purpose: To determine if medical factors exist to put the child at risk for hearing loss.

Description: A review of the history questions with the parent or caregiver.

Equipment: None.

Facilities: Comfortable, private interview area.

Procedure: Question the parent/caregiver about the child's hearing history.

WNL: No positive response to hearing history.

Rescreen/Refer: A positive response to one or more of the history questions should be used as a reason for referral **only** if the child cannot be screened.

1. Is there concern that this child has a hearing problem?
2. Are there any hearing problems in the family of either the child's mother or father?
3. Does child have history of middle ear disease and/or tubes?
4. Has child had serious head trauma with concussion, skull fracture or loss of consciousness?
5. Has child been hospitalized with a serious illness?

SCREENING PROCEDURES

Checklist of Auditory & Communication Development

Ages/Grades: Birth to 3 years.

Purpose: To check development of auditory and communication behaviors.

Description: Determine auditory/communication skills of the child by using parent/ caregiver interview and/or observation of child.

Equipment: None.

Facilities: Comfortable, private interview area.

Procedure: Through interview or by observation of the child determine if the child exhibits all behaviors in the appropriate age group using the Checklist of Auditory/Communication Development. If the child does not have any of the age-appropriate behaviors, try the behaviors listed in next youngest category.

WNL: Child exhibits one or more behaviors in their age group.

Rescreen/Refer: Child exhibits **NO** behaviors in their age group.

CHECKLIST OF AUDITORY & COMMUNICATION DEVELOPMENT

NAME_____ **DATE**_____

Birth to Three Months
- ___ Startle
- ___ Quieted by familiar voice
- ___ Responds to speaker with smile
- ___* Shifts eyes to speaker
- ___ Reflexive vocalizations

Three to Six Months
- ___ Coos, grunts, squeals, raspberries
- ___ Cries with purpose
- ___* Turns to voice
- ___ Stops crying when talked to
- ___ Laughs during play
- ___ Turns to sound out of sight

Six to Nine Months
- ___ Responds w/vocalization to name *(50%)*
- ___ Simple babbling *(different consonant vowel combinations ba-da-gu-da)*
- ___* Localizes to side
- ___* Participation in "peek-a-boo"
- ___ Stops activity when name is called
- ___ Inhibits to "no"

Nine to Twelve Months
- ___ Follows verbal request w/o gesture
- ___ First word emerges
- ___ Imitates familiar words

Twelve to Sixteen Months
- ___ Uses words + gestures to obtain an object
- ___ Will sustain interest for 2 or more minutes looking at pictures as they are named
- ___ Brings objects from another room

Sixteen to Eighteen Months
- ___ Carries out two consecutive directions with an object *(give mommy the ball, take the ball to daddy)*
- ___ Points to one common body part *(eyes, nose, tummy)*
- ___ Three words other than mama, dada
- ___ Points to named objects *(cup, spoon, ball)*

Eighteen to Twenty Months
- ___ Responds to action words *(sit down, come here, stop that)*
- ___ Vocabulary of 1-50 words
- ___ >50% of speech is understood by strangers

Twenty to Twenty-two Months
- ___ Rapidly expands vocabulary
- ___ Follows simple 2-step command *(give me that ball, then give the spoon to mommy)*
- ___ Identifies three common body parts *(eyes, nose, ears, hair, toes)*
- ___ >50% of speech is understood by strangers

Twenty-Two to Twenty-Four Months
- ___ May begin to use 2-word phrases *(want cookie, mommy bye-bye)*
- ___ Refers to self with own name
- ___ Uses no + noun for negation *(no milk, no night-night)*
- ___ >75% of speech is understood by strangers

Twenty-four to Twenty-seven Months
- ___ Uses most personal pronouns correctly
- ___ Points to picture of action word
- ___ 3-word phrases begin to emerge
- ___ >75% of speech is understood by strangers

Twenty-seven to Thirty Months
- ___ Understands big and little
- ___ Repeats 2 + numbers correctly
- ___ Hears telephone ring, enjoys talking on telephone
- ___ >75% of speech is understood by strangers

Thirty Months to Thirty-three Months
- ___ Gives first and last name
- ___ Understands common verbs: cold, tired, hurt
- ___ Sits at a normal distance from T.V. without turning up the volume
- ___ Almost all of speech is understood by strangers

Thirty-three to Thirty-six Months
- ___ Uses 3-word sentences consistently
- ___ Understands simple prepositions *(in, on, under)*
- ___ Almost all of speech is understood by strangers

A child is at risk when no behaviors in their age group are exhibited.

* A vision as well as a hearing problem should be suspected if these skills do not emerge at this age.

Sources for Behaviors: Early Language Milestone Scale (ELMS), Denver Developmental Screening Test (DDST), Clinical Linguistic and Auditory Milestone Scale (CLAMS), Receptive and Expressive Emergent Language (REEL) Scale, Sequenced Inventory of Child Development (SICD).

SCREENING PROCEDURES

EXTERNAL INSPECTION & OTOSCOPY

Ages/Grades: Birth to 3 years.

Purpose: To check for signs of ear disease and/or abnormal development.

Description: A systematic inspection of the external ear canal, surrounding tissue, ear canal, and tympanic membrane.

Equipment: External inspection - None.
Otoscopy - otoscope.

Facilities: A well-lighted area.

Procedure: **External:** Inspect the pinna and the area around it for set of the ears, skin tags or sinuses, tenderness, redness or edema, signs of drainage or wax build-up in the outer 1/3 of the canal.

Otoscopy: With the otoscope, inspect the ear canal and tympanic membrane for: signs of drainage, wax build-up, or damage to the ear canal. Also note whether normal landmarks on the tympanic membrane can be seen. If the screener lacks training and experience in using the otoscope, visual inspection of the ear should be limited to the "external" inspection.

WNL: Normal appearance of all structures and no complaints of pain when the pinna or the tissue around the ear is being manipulated.

Rescreen/Refer: Refer any abnormality for medical examination.

SCREENING PROCEDURES

TYMPANOMETRY

Ages/Grades: 6 months to 3 years.

Purpose: To check middle ear function.

Description: Measurement of movement of the tympanic membrance and middle ear system under varying air pressures.

Equipment: Tympanometer.

Facilities: Well-lighted area.

Procedure: Seal the ear canal and start the tympanometer according to the manufacturer's instructions. Most equipment will automatically print out a tympanogram.

WNL: Ears which demonstrate normal pressure-admittance curves. Pressure should fall between +50 and -250 daPa. Admittance must be at 0.3 mmho or higher.

Rescreen/Refer: Pressure and/or admittance falls outside the guidelines. **Rescreen in 4-6 weeks if tympanometry alone is not WNL,** otherwise rescreen in 2-3 weeks along with the pure tone rescreen. If the tympanogram is still the only procedure outside the guidelines at the later date a referral should be made.

SCREENING PROCEDURES FOR

EARLY CHILDHOOD

3 TO 5 YEARS

- HEARING HISTORY
- EXTERNAL INSPECTION & OTOSCOPY
- TYMPANOMETRY
- PURE TONE SCREENING
- PURE TONE THRESHOLD SCREENING
- PLAY AUDIOMETRY

SCREENING PROCEDURES

HEARING HISTORY

Ages/Grades: 3 to 5 years.

Purpose: To determine if medical factors exist to put the child at risk for hearing loss.

Description: A review of the history questions with the parent or caregiver.

Equipment: None.

Facilities: Comfortable, private interview area.

Procedure: Question the parent/caregiver about the child's hearing history.

WNL: No positive response to hearing history.

Rescreen/Refer: A positive response to one or more of the history questions should be used as a reason for referral **only** if the child cannot be screened.

1. Is there concern that this child has a hearing problem?
2. Are there any hearing problems in the family of either the child's mother or father?
3. Does child have history of middle ear disease and/or tubes?
4. Has child had serious head trauma with concussion, skull fracture or loss of consciousness?
5. Has child been hospitalized with a serious illness?

SCREENING PROCEDURES

EXTERNAL INSPECTION & OTOSCOPY

Ages/Grades: 3 to 5 years.

Purpose: To check for signs of ear disease and/or abnormal development.

Description: A systematic inspection of the external ear canal, surrounding tissue, ear canal, and tympanic membrane.

Equipment: External inspection - None.
Otoscopy - otoscope.

Facilities: A well-lighted area.

Procedure: **External:** Inspect the pinna and the area around it for set of the ears, skin tags or sinuses, tenderness, redness or edema, signs of drainage or wax build-up in the outer 1/3 of the canal.

Otoscopy: With the otoscope, inspect the ear canal and tympanic membrane for: signs of drainage, wax build-up, or damage to the ear canal. Also note whether normal landmarks on the tympanic membrane can be seen. If the screener lacks training and experience in using the otoscope, visual inspection of the ear should be limited to the "external" visual inspection.

WNL: Normal appearance of all structures and no complaints of pain when the pinna or the tissue around the ear is being manipulated.

Rescreen/Refer: Refer any abnormality for medical examination.

SCREENING PROCEDURES

TYMPANOMETRY

Ages/Grades: 3 to 5 years.

Purpose: To check middle ear function.

Description: Measurement of movement of the tympanic membrane and middle ear system under varying air pressures.

Equipment: Tympanometer.

Facilities: Well-lighted area.

Procedure: Seal the ear canal and start the tympanometer according to the manufacturer's instructions. Most equipment will automatically print out a tympanogram.

WNL: Ears which demonstrate normal pressure-admittance curves. Pressure should fall between +50 and -250 daPa. Admittance must be at 0.3 mmho or higher.

Rescreen/Refer: Pressure and/or admittance falls outside the guidelines. **Rescreen in 4-6 weeks if tympanometry alone is not WNL,** otherwise rescreen in 2-3 weeks along with the pure tone rescreen. If the tympanogram is still the only procedure outside the guidelines at the later date a referral should be made.

SCREENING PROCEDURES

PURE TONE SCREENING

Ages/Grades: 3 to 5 years.

Purpose: To identify children with suspected hearing loss.

Description: Have the child listen to a series of pure tones and note whether or not there was a valid response to each tone.

Equipment: Pure tone audiometer.

Facilities: Quiet room/area, free from visual distractions.

Procedure:

Set Up:

- Seat the children so they cannot see the front of the audiometer.
- Remove glasses, hair bands, large earrings, etc.
- Place hair behind the ears.
- Instruct the child to raise either hand when a tone is heard.
- Set selector switch to Right.
- Set HL dial to 40 dB.
- Set frequency dial to 1000 Hz.
- Place the earphones on child's head with the red phone on the right ear and the headband flush to the head.

Screening:

- Present the 1000 Hz 40 dB tone for 1-2 seconds.
- Turn HL dial to 20 dB.
- Present tones at 1000, 2000 and 4000 Hz.
- Turn selector switch to left.
- Present tones at 4000, 2000 and 1000 Hz.
- Set HL dial at 25 dB.
- Turn frequency dial to 500 Hz.
- Present the tone.
- Turn selector switch to right.
- Present the tone.
- Recheck immediately if the child did not hear one or more tones.
- Place a check mark in the proper boxes on the screening form if a child does not respond to the tone(s).

WNL: Child responds to all eight tones.

Rescreen: Child did not respond to one or more tones in the immediate rescreening is scheduled for another rescreening in 14-21 days.
NOTE: The 500 Hz tone may be eliminated when tympanometry is included or when the ambient noise level is too high. (See: Environmental Noise Level Check - Appendix A)

SCREENING PROCEDURES

PURE TONE THRESHOLD SCREENING

Ages/Grades: 3 to 5 years (does not respond to one or more tones at rescreening).

Purpose: To obtain a record of the child's level of hearing prior to initial referral.

Description: Have the child listen to a series of pure tones and record the softest dB level that the child responds to at each frequency.

Equipment: Pure tone audiometer.

Facilities: Quiet room, free from visual distractions.

Procedure:

Set Up:

- Seat the children so they cannot see the front of the audiometer.
- Remove glasses, hair bands, large earrings, etc.
- Place hair behind the ears.
- Instruct the child to raise either hand when a tone is heard.
- Set selector switch to Right.
- Set HL dial to 40 dB.
- Set frequency dial to 1000 Hz.
- Place the earphones on child's head with the red phone on the right ear and the headband flush to the head.

Threshold Determination:

- Screen right or better ear.
- Present the 1000 Hz tone at 40, 20, 0 dB until there is no response.
- At the level there is no response, increase in 5 dB increments until there is response.
- Drop 10 dB.
- Increase in 5 dB increments until there is a response.
- Repeat until there are 2 responses at the same level.
- Record threshold level.
- Repeat the process for 2000, 4000, 8000, recheck 1000 Hz and 500 Hz in the right or better ear.
- Repeat for the other ear.

WNL: Child's threshold is above the bold line on the audiogram (20dB at 500 Hz, 15dB at 1000, 2000, 4000 Hz).

Referral: Any threshold level on or below the bold line on the audiogram (25dB at 500 Hz, 20dB at 1000, 2000, 4000 Hz).

Exceptions: When a child has a known hearing loss that has been diagnosed as non-treatable, referral to the school audiologist should be made if there is a change of 10dB poorer at any frequency.

NOTE: For the child who does not raise their hand use the play audiometry procedures as described on the next page.

SCREENING PROCEDURES

PLAY AUDIOMETRY

Ages/Grades: The difficult to screen child 3 to 5 years.

Purpose: To obtain valid results with children when a hand raising response to the stimulus is not effective.

Description: A modification of the standard pure tone screening procedure in which the child is conditioned to respond to the sound by placing a toy in a container. This replaces the hand raising technique normally used.

Equipment: Pure tone audiometer, stickers, and interesting, child safe toys i.e., animals, airplanes, cars, beads, clothes pins, pegs and pegboard or nested boxes.

Facilities: Appropriate size table and chairs in a quiet, comfortable setting with some degree of privacy.

Procedure: Place the headphones on the table facing the child with the audiometer set at 2000 Hz and the maximum level to insure the tone is audible. Screener holds the toy near their own ear, assumes a "listening attitude and presents the tone. Indicate through facial expression that the sound was heard and then drop the toy into the container. This may be repeated as often as necessary until the child shows interest.

Screener offers the toy to the child and places their hand on the child's to guide the first responses. Encourage the child to wait until the sound is heard. When child appears ready present the sound and guide the child's hand to put the toy in the container. Child may give consistent responses after only one demonstration or may need several to respond on their own. Demonstrate first without and then with the headset on.

Reward the child with praise after the initial response. If this is not effective a tangible reward, such as a sticker or food, may be given.

Other: The response interval (tone to response time) varies between children. Some children will drop the toy as soon as the tone is heard, others will wait until the sound goes off before dropping the toy.

If the child does not accept the headset, the screener should try putting it on for only one or two seconds, remove and reward the child. The time with the headset on should be slowly increased.

A timid child will often benefit from watching one or two other children successfully complete the screening.

SCREENING PROCEDURES FOR

SCHOOL AGE CHILDREN

- PARENT/TEACHER/CHILD OBSERVATION
- EXTERNAL INSPECTION & OTOSCOPY
- TYMPANOMETRY
- PURE TONE SCREENING
- PURE TONE THRESHOLD SCREENING
- PLAY AUDIOMETRY

SCREENING PROCEDURES

PARENT/TEACHER/CHILD OBSERVATION

Ages/Grades: All grades.

Purpose: To extend the identification of suspected ear problems or hearing losses throughout the year.

Description: Reporting complaints or observed abnormal listening behaviors.

Equipment: None.

Facilities: None.

Procedure: Child is asked to report any complaint about his/her ears. Parents and/or teachers are asked to report any abnormal listening behaviors.

Complaints:
- pain in ear
- fullness in ear
- noise in ears
- drainage
- cannot hear

Behaviors:
- tugging at ear
- asks to have things repeated
- turns side of head toward speaker
- inattentive in class discussion
- watches teachers' lips
- shows strain when listening
- difficulty with phonics
- frequent mistakes in following directions
- day dreaming
- tends to isolate
- tires easily
- talks too loudly or softly
- has a speech problem
- not working to capacity
- tends to be passive

Rescreen/Refer: Any child with complaints or observed abnormal listening behaviors should be seen by the referral/follow-up professional to determine the appropriate course of evaluation.

NOTE: This list of potential indicators of hearing loss should be given to teachers in the beginning of the school year so they can be alerted to children who should have their hearing checked.

EXTERNAL INSPECTION & OTOSCOPY

Ages/Grades: All grades.

Purpose: To check for signs of ear disease and/or abnormal development.

Description: A systematic inspection of the external ear canal, surrounding tissue, ear canal, and tympanic membrane.

Equipment: External inspection - None.
Otoscopy - otoscope.

Facilities: A well-lighted area.

Procedure: **External:** Inspect the pinna and the area around it for set of the ears, skin tags or sinuses, tenderness, redness or edema, signs of drainage or wax build-up in the outer 1/3 of the canal.

Otoscopy: With the otoscope, inspect the ear canal and tympanic membrane for: signs of drainage, wax build-up, or damage to the ear canal. Also note whether normal landmarks on the tympanic membrane can be seen. If the screener lacks training and experience in using the otoscope, visual inspection of the ear should be limited to the "external" inspection.

WNL: Normal appearance of all structures and no complaints of pain when the pinna or the tissue around the ear is being manipulated.

Rescreen/Refer: Refer any abnormality previously undetected for medical examination.

SCREENING PROCEDURES

TYMPANOMETRY

Ages/Grades: Kindergarten through 3rd grade and others as indicated.

Purpose: To check middle ear function.

Description: Measurement of movement of the tympanic membrane and middle ear system under varying air pressures.

Equipment: Tympanometer.

Facilities: Well-lighted area.

Procedure: Seal the ear canal and start the tympanometer according to the manufacturer's instructions. Most equipment will automatically print out a tympanogram.

WNL: Ears which demonstrate normal pressure-admittance curves. Pressure should fall between +50 and -250 daPa. Admittance must be at 0.3 mmho or higher.

Rescreen/Refer: Pressure and/or admittance falls outside the guidelines.
Rescreen in 4-6 weeks if tympanometry alone is not WNL, otherwise rescreen in 2-3 weeks along with the pure tone rescreen. If the tympanogram is still the only procedure outside the guidelines at the later date a referral should be made.

SCREENING PROCEDURES

PURE TONE SCREENING

Ages/Grades: All grades.

Purpose: To identify children with suspected hearing loss.

Description: Have the child listen to a series of pure tones and note whether or not there was a valid response to each tone.

Equipment: Pure tone audiometer.

Facilities: Quiet room/area, free from visual distractions.

Procedure:

Set Up:

- Seat the children so they cannot see the front of the audiometer.
- Remove glasses, hair bands, large earrings, etc.
- Place hair behind the ears.
- Instruct the child to raise either hand when a tone is heard.
- Set selector switch to Right.
- Set HL dial to 40 dB.
- Set frequency dial to 1000 Hz.
- Place the earphones on child's head with the red phone on the right ear and the headband flush to the head.

Screening:

- Present the 1000 Hz 40 dB tone for 1-2 seconds.
- Turn HL dial to 20 dB.
- Present tones at 1000, 2000 and 4000 Hz.
- Turn selector switch to left.
- Present tones at 4000, 2000 and 1000 Hz.
- Set HL dial at 25 dB.
- Turn frequency dial to 500 Hz.
- Present the tone.
- Turn selector switch to right.
- Present the tone.
- Recheck immediately if the child did not hear one or more tones.
- Place a check mark in the proper boxes on the screening form if a child does not respond to the tone(s).

WNL: Child responds to all eight tones.

Rescreen: Child did not respond to one or more tones in the immediate rescreening, is scheduled for another rescreening in 14-21 days.

NOTE: The 500 Hz tone may be eliminated when tympanometry is included or when the ambient noise level is too high. (See: Environmental Noise Level Check - Appendix A)

SCREENING PROCEDURES

PURE TONE THRESHOLD SCREENING

Ages/Grades: All grades (does not respond to one or more tones at rescreening).

Purpose: To obtain a record of the child's level of hearing prior to initial referral.

Description: Have the child listen to a series of pure tones and record the softest dB level that the child responds to at each frequency.

Equipment: Pure tone audiometer.

Facilities: Quiet room, free from visual distractions.

Procedure:

Set Up:

- Seat the children so they cannot see the front of the audiometer.
- Remove glasses, hair bands, large earrings, etc.
- Place hair behind the ears.
- Instruct the child to raise either hand when a tone is heard.
- Set selector switch to Right.
- Set HL dial to 40 dB.
- Set frequency dial to 1000 Hz.
- Place the earphones on child's head with the red phone on the right ear and the headband flush to the head.

Threshold Determination:

- Screen right or better ear.
- Present the 1000 Hz tone at 40, 20, 0 dB until there is no response.
- At the level there is no response, increase in 5 dB increments until there is response.
- Drop 10 dB.
- Increase in 5 dB increments until there is a response.
- Repeat until there are 2 responses at the same level.
- Record threshold level.
- Repeat the process for 2000, 4000, 8000, recheck 1000 Hz and 500 Hz in the right or better ear.
- Repeat for the other ear.

WNL: Child's threshold is above the bold line on the audiogram (20dB at 500 Hz, 15dB at 1000, 2000, 4000 Hz).

Referral: Any threshold level on or below the bold line on the audiogram (25dB at 500 Hz, 20dB at 1000, 2000, 4000 Hz).

Exceptions: When a child has a known hearing loss that has been diagnosed as non-treatable, referral to the local school audiologist should be made if there is a change of 10dB poorer at any frequency.

NOTE: For children who are difficult to screen, use the play audiometry procedures as described on the next page.

SCREENING PROCEDURES

PLAY AUDIOMETRY

Ages/Grades: The difficult to screen child.

Purpose: To obtain valid results with a younger child when a hand raising response to the stimulus can not be obtained.

Description: A modification of the standard pure tone screening procedure in which the child is conditioned to respond to the sound by placing a toy in a container. This replaces the hand raising technique normally used.

Equipment: Pure tone audiometer, stickers, and interesting, child safe toys i.e., animals, airplanes, cars, beads, clothes pins, pegs and pegboard or nested boxes.

Facilities: Appropriate size table and chairs in a quiet, comfortable setting with some degree of privacy.

Procedure: Place the headphones on the table facing the child with the audiometer set at 2000 Hz and the maximum level to insure the tone is audible.

Screener holds the toy near their own ear, assumes a "listening attitude and presents the tone. Indicate through facial expression that the sound was heard and then drop the toy into the container. This may be repeated as often as necessary until the child shows interest.

Screener offers the toy to the child and places their hand on the child's to guide the first responses. Encourage the child to wait until the sound is heard. When child appears ready present the sound and guide the child's hand to put the toy in the container. Child may give consistent responses after only one demonstration or may need several to respond on their own. Demonstrate first without and then with the headset on.

Reward the child with praise after the initial response. If this is not effective a tangible reward, like a sticker or food, may be given.

Other: The response interval (tone to response time) varies between children. Some children will drop the toy as soon as the tone is heard, others will wait until the sound goes off before dropping the toy.

If the child does not accept the headset, the screener should try putting it on for only one or two seconds, remove and reward the child. The time with the headset on should be slowly increased.

A timid child will often benefit from watching one or two other children successfully complete the screening.

APPENDIX A

- GLOSSARY
- FREQUENCY OF SCREENING
- ENVIRONMENTAL NOISE LEVEL CHECK
- MECHANICAL FUNCTION AND CHECK SHEET
- BIOLOGIC CALIBRATION AND CHECK SHEET

GLOSSARY

Admittance - measurement taken during tympanometery showing the mobility of the tympanic membrane as a function of the air pressure in the ear canal. The unit is millimho (mmho).

Ambient Noise - background noise present in the screening area.

ANSI - American National Standards Institute.

Auditory Brainstem Responses (ABR) - technique which measures changes in brain waves in response to sound. ABR is used to test infants and other difficult to test individuals.

Automated ABR - ABR obtained from infants still in hospital nurseries to determine hearing loss.

Calibration Checks - determines the accuracy of an audiometer. Two methods used are:

1. Biological - checking the audiometer against a known hearing level.
2. **Electronic** - measurement of the absolute sound pressure levels of each frequency and other characteristics, e.g., harmonic distortion, frequency count and rise-fall time.

Compliance - term that is often used incorrectly to mean admittance.

deca Pascals (daPa) - unit of measurement of the pressure used in tympanometry. The usual measured range is from +200 daPa to -400 daPa.

Decibel (dB) - logarithmic unit that expresses the intensity of a sound.

Frequency - number of vibrations of a sound wave in one second expressed as Hertz.

Hertz (Hz) - international term for cycles per second in measuring frequency of sound waves.

High Risk - children who have one or more of the risk factors known to impact hearing.

Intensity - strength of vibrations of a sound wave, expressed in decibels (dB).

Loudness - psychological correlate of intensity.

Otoacoustic Emissions - narrow band signals emitted by the cochlea either spontaneously or in response to acoustic stimulation. These emissions can be measured to help determine if hearing loss is present.

Pitch - psychological correlate of frequency.

Pure Tone - tone of a single frequency.

Threshold - minimal level at which an individual is able to respond to a sound least 50% of the time.

FREQUENCY OF SCREENING

In the **school setting**, all children in kindergarten and grades 1, 2, 3, 5, 8 and 11 should be screened each year. In addition, parent, teacher and child referrals, new students, children with known losses, special education classes, and high risk children should also be included in the yearly screening. High risk students are those children who have:

1. Chronic or recurrent otitis media
2. Cleft palate or other cra io-facial anomalies
3. Family history of developing hearing problems
4. Exposure to potentially harmful levels of noise

The **Early Childhood Screening** law (M§ 123.701-123.702) requires that children be screened once before school entry. This usually occurs in the 3-5 year age range.

The **Child and Teen Checkups** (M§ 256B.04-256B.0625) program recommends hearing be screened as follows:

Infancy 1 month, 2 months, 4 months, 6 months, 9 months, 12 months

Early Childhood: 15 months, 18 months, 24 months, 3 years, 4 years

Late Childhood: 5 years, 6 years, 8 years, 10 years, 12 years

Adolescence: 14 years, 16 years, 18 years, 20 years

ENVIRONMENTAL NOISE LEVEL CHECK

Most local agencies and schools do not have the equipment to take ambient noise level measurements in the areas to be used for screening. **A BIOLOGIC NOISE LEVEL CHECK MAY BE SUBSTITUTED. THIS IS DEFINED AS THE ABILITY OF A PERSON WITH NORMAL HEARING TO ESTABLISH THRESHOLDS 10dB BELOW THE SCREENING LEVEL AT ALL FREQUENCIES.** If these thresholds cannot be established, the area must not be used for screening. However, if 500 Hz is the only frequency affected, then it may be deleted from the screening protocol.

MECHANICAL FUNCTION

Before using the audiometer, plug it in for ten minutes and then check the mechanical function. (Form on reverse side.)

1. **Power** - make sure there **is** power to the audiometer.

2. **Jacks** - make sure the jacks are in the proper receptacle and are all the way in.

3. **Earphone Cushions** - cushions should be clean, pliable and free from breaks or tears.

4. **Dials** - turn the frequency and attenuator dials to check for slippage. Loose dials should be tightened before the audiometer is used.

5. **Headband Tension** - with the earphones on there should be enough tension so that they rest snugly on the ears.

6. **Tone On/Off (Rev/Norm)** - turn the switch to ON (NORM) position and the sound should be on. The sound should be off in OFF (REV) position.

7. **Cords** - with the selector switch on "right", turn the tone interrupter switch to the ON or NORM position. Gently twist the cord by the right earphone and at the jack position; turn the sound to "left" and check the left cord. If the sound cuts out or becomes scratchy, the connections must be tightened or the cords replaced.

8. **Volume Increase/Decrease** - turn the Hearing Level (HL) dial and listen for loudness changes. This may also be referred to as the Hearing Threshold Dial (HTL).

9. **Pitch Change** - change the frequency dial and listen for changes in pitch.

10. **Tone Presenter Switch(es)** - press the switch and the sound should come on if the tone is in the OFF (REV) position. If the tone is in the ON (NORM) position, the tone should go off when the switch is pushed. Check both switches if the audiometer is so equipped.

11. **Static** - may indicate dirty contacts. This can be cleared by rotating the dials quickly.

12. **Cross Talk** - when the tone is directed into one phone no sound should be present in the other.

MECHANICAL FUNCTION CHECK SHEET

DATE	Power On	Jacks Seated	Earphone Cushions	Dials Tight	Head Band Tension	Tone On/Off	Cords OK	Volume Inc/Dec	Pitch Change	Tone Presenter	No Static	No Cross Talk

BIOLOGIC CALIBRATION

To insure that the audiometer is in calibration, biologic calibration checks should be done each day prior to use or anytime during use when there is reason to suspect the audiometer may not be working properly. Use the procedure described below. (Form on reverse side.)

1. Obtain a threshold (500-8000 Hz) on the better ear with right (red) earphone - record the results.

2. Obtain a threshold (500-8000 Hz) on the same ear with the left (blue) earphone - record the results.

3. Check the thresholds at each frequency to see that they differ by no more that ±5 dB. If they vary more than this then the audiometer must be checked electronically.

BIOLOGIC CALIBRATION CHECK SHEET

Audiometer I.D. _____

Date	Phone	500	1000	2000	4000	8000	Screener
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						
	Red						
	Blue						

APPENDIX B

- FORMS AND INSTRUCTIONS
- SCHOOL HEARING SCREENING WORKSHEET
- HEARING REFERRAL LETTER
- PARENT INFORMATION
- HEARING AND VISION SCREENING REPORT AND DIRECTIONS
- EARLY CHILDHOOD HEARING SCREENING WORKSHEET
- EARLY CHILDHOOD VISION SCREENING WORKSHEET
- AUDIOGRAM

FORMS AND INSTRUCTIONS

Forms in this section may be reproduced for use with the screening programs.

School Hearing Screening Worksheet:

One form is needed for each child to be screened. The teacher fills in any parental comments and classroom observations of possible hearing problems under Parent/Teacher Observations. At the time of screening, the screener enters any of the child's or his/her own observations. When screening is completed, the appropriate "WNL" or "Rescreen" space is checked. After the screening program is completed, the results are transferred to the child's school health record and these worksheets may be discarded.

Hearing Referral Letter:

This letter is recommended to inform parents of the screening results and obtain follow-up information from the professional examiner. The letter should be mailed to the parents as soon as possible after referral determination is made.

Parent Information:

This guide to how a baby uses hearing is designed as a handout that can duplicated, discussed with the parent/caregiver and then given to them for their use as an aid when reporting on the child's hearing history at later visits.

Hearing and Vision Screening Report:

This report provides the Minnesota Department of Health (Hearing and Vision Conservation Program) with general screening data to assess the scope and accomplishments of the program on a statewide basis. This form may be submitted for an entire program or by individual locations (i.e., schools within a district). Local Boards of Health, report hearing and vision screening activities as part of the Community Health Services Annual Report, however, items of data on the Hearing and Vision Screening Report form which are helpful to the department's quality assurance monitoring efforts are not gathered by that report. Accordingly, the Hearing and Vision Conservation Program would appreciate having the form submitted on a voluntary basis.

Early Childhood Hearing and Vision Worksheets:

One form is needed for each child to be screened. The screener records the information in the appropriate spaces on the worksheet. When screening is completed, the form is maintained in the child's C&TC or ECS record and transferred to the child's school health record at school entry.

Audiogram:

This form is to be completed for each child who is to be referred. One copy is attached to the referral letter. A second copy is kept in the child's school health record to use for comparison with past/future audiograms.

School Hearing Screening Worksheet

Child's Name _____

Teacher_____ Room_____ Grade_____

Parent/Teacher/Child Observations:

Visual Inspection:

	WNL	Rescreen
External		
Otoscopy		

Tympanometry Results: WNL ☐ RESCREEN ☐

Pure Tone:
[WNL = Within Normal Limits URI = Upper Respiratory Infection]

Screen: ☐ URI ☐ WNL ☐ Rescreen

Level	25	20	20	20
Frequency	500	1000	2000	4000
Right Ear				
Left Ear				

Rescreen: ☐ URI ☐ WNL ☐ Rescreen

Level	25	20	20	20
Frequency	500	1000	2000	4000
Right Ear				
Left Ear				

Threshold in HL: ☐ URI Date_____

Frequency	500	1000	2000	4000	8000
Right Ear					
Left Ear					

Reliability: ☐ Good ☐ Fair ☐ Poor

School Hearing Screening Worksheet

Child's Name _____

Teacher_____ Room_____ Grade_____

Parent/Teacher/Child Observations:

Visual Inspection:

	WNL	Rescreen
External		
Otoscopy		

Tympanometry Results: WNL ☐ RESCREEN ☐

Pure Tone:
[WNL = Within Normal Limits URI = Upper Respiratory Infection]

Screen: ☐ URI ☐ WNL ☐ Rescreen

Level	25	20	20	20
Frequency	500	1000	2000	4000
Right Ear				
Left Ear				

Rescreen: ☐ URI ☐ WNL ☐ Rescreen

Level	25	20	20	20
Frequency	500	1000	2000	4000
Right Ear				
Left Ear				

Threshold in HL: ☐ URI Date_____

Frequency	500	1000	2000	4000	8000
Right Ear					
Left Ear					

Reliability: ☐ Good ☐ Fair ☐ Poor

HEARING REFERRAL LETTER

Name: _____

Dear Parent:
In keeping with the recommendations of the Minnesota Department of Health, your child was screened for hearing on _____ and rescreened on _____.

Your child was unable to hear all of the screening sounds. Although the results do not definitely mean your child has a hearing problem, you are urged to take him/her to your physician and/or audiologist for further hearing evaluation.

Please take this letter with you when your child is examined and ask the examiner to complete the bottom half.

- - - -

PARENT INFORMATION

A Guide To How Your Baby Uses Hearing

Auditory/Communication Development Questions

Ages Birth to Six Months

1. Does your child startle to loud sounds?
2. Is your child quieted by a familiar voice?
3. Does your child stop crying when talked to?
4. Does your child laugh during play?

Ages Six Months to Twelve Months

1. Does your child cease activity when her/his name is called?
2. Does your child participate in playing "peek-a-boo?"
3. By age 8 months, has your child begun to babble?
4. Does your child enjoy playing with, and listening to, musical toys?

Ages Twelve to Eighteen Months

1. Does your child use words plus gestures to obtain a toy or object?
2. Can your child sustain interest for 2 or more minutes in looking at pictures as they are named?
3. Does your child use three words other than "mama," "dada"?"
4. Can your child point to one common body part (eyes, nose, tummy)?

Ages Eighteen to Twenty-four Months

1. Does your child show understanding by responding to action words such as, "sit down," "come here" and "give it to mama?"
2. Can your child identify three common body parts?
3. Does your child have a vocabulary of 10-50 words?
4. Does your child refer to self with his/her own name?

Ages Twenty-four to Thirty-six Months

1. Does your child use 2- and 3- word phrases?
2. Does your child understand "big" and "little?"
3. Does your child understand common words: "cold, tired, hungry?"
4. Does your child hear the telephone ring? Enjoy talking on the telephone?
5. Does your child sit at a normal distance from a television set at a normal volume?

A concern about any item should be discussed by the parents/ caregiver with the primary health care provider and ask about a referral to an audiologist.

HEARING AND VISION SCREENING REPORT

(see instructions on back)

LOCATION: _____ _____ _____
(School or Site) (City) (County)

ENROLLMENT: _____ **DATES:** _____ _____
(Screen) (Rescreen)

TYPE OF PROGRAM: ____ School ____ Early Childhood Screening

GRADES SCREENED: HEARING: K 1 2 3 4 5 6 7 9 10 11 12
VISION: K 1 2 3 4 5 6 7 9 10 11 12

	# Screened	# Rescreened	# Referred
HEARING:			
Puretone	_____	_____	_____
Tympanometry	_____	_____	_____
VISION:	_____	_____	_____

SUBMITTED BY:_____ **POSITION:**_____ **PHONE:** (___) _____
SEND TO: Hearing & Vision Conservation Program, Minnesota Department of Health
717 Delaware Street S.E., P.O. Box 9441, Minneapolis, MN 55440-9441

- - - -

Directions for Hearing and Vision Screening Report

ENROLLMENT: Enter total school or ECS enrollment.

GRADES SCREENED: Circle grades screened for vision and grades screened for hearing.

 # SCREENED: Include number of children on initial screening date and those seen for the first time on the rescreening date.

 # RESCREENED: Show number of children rescreened.

 # REFERRED: Show number of children referred for a professional evaluation.

Directions for Hearing and Vision Screening Report

ENROLLMENT: Enter total school or ECS enrollment.

GRADES SCREENED: Circle grades screened for vision and grades screened for hearing.

 # SCREENED: Include number of children on initial screening date and those seen for the first time on the rescreening date.

 # RESCREENED: Show number of children rescreened.

 # REFERRED: Show number of children referred for a professional evaluation.

EARLY CHILDHOOD HEARING SCREENING WORKSHEET

(Also used for Child and Teen Checkup)

[Note: URI = Upper Respiratory Infection WNL = Within Normal Limits]

Name _____ Age ___ | ___ Yrs Mos Dates SCREEN ___ | ___ RESCREEN ___ | ___

Problem Noted:	SCREEN NO	SCREEN YES	RESCREEN NO	RESCREEN YES
A. Risk Factors (29 days to 3 years)				
B. Hearing History (all ages)				
C. Auditory Checklist (birth to 36 mos.)				
D. Visual Inspection/Otoscopy (all ages)				
E. Tympanometry (6 mos.+) If problem noted attach tympanogram				
F. Pure tone (3 years)				

PURE TONE:

Screen: ☐ URI ☐ WNL ☐ Rescreen

Level	25	20	20	20
Frequency	500	1000	2000	4000
Right Ear				
Left Ear				

Rescreen: ☐ URI ☐ WNL ☐ Rescreen

Level	25	20	20	20
Frequency	500	1000	2000	4000
Right Ear				
Left Ear				

Threshold in HL: ☐ URI Date ___/___/___

Frequency	500	1000	2000	4000	8000
Right Ear					
Left Ear					

Reliability: ☐ Good ☐ Fair ☐ Poor

HEARING HISTORY *(all ages)*:

1. Is there concern that this child has a hearing problem?
2. Are there any hearing problems in the family of either the child's mother or father?
3. Does child have history of middle ear disease and/or tubes?
4. Has child had serious head trauma with concussion, skull fracture or loss of consciousness?
5. Has child been hospitalized with a serious illness?

EARLY CHILDHOOD VISION SCREENING WORKSHEET

(Also used for Child and Teen Checkup)

NAME: | AGE: Yrs. Mo. | DATES:

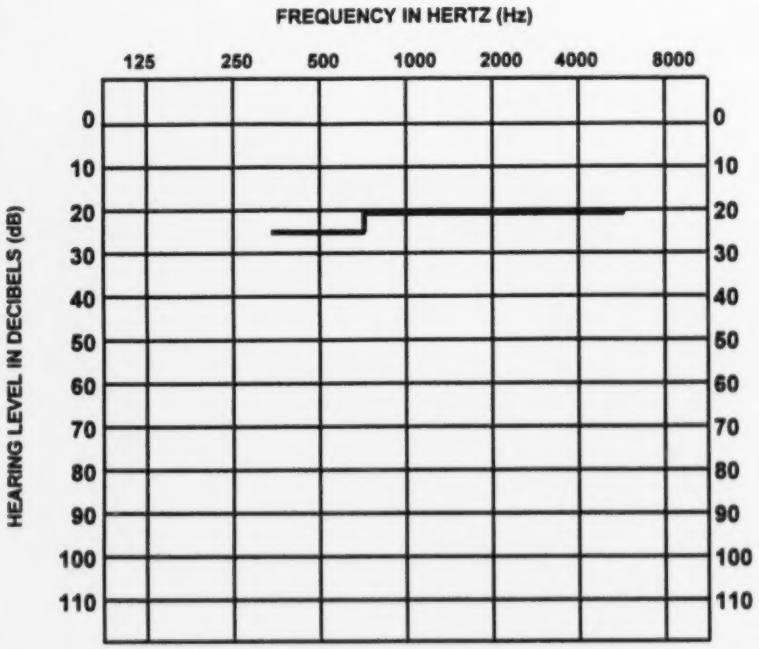
	SCREEN		RESCREEN	
	NO	YES	NO	YES
Does child have glasses or contacts?				
Wearing them during screening?				
Problem Noted:				
A. Observation (6 months - 3rd grade)				
B. External Inspection (6 months and older) WIPL				
C. Corneal Light Reflection (6 months - 3rd grade)				
D. Cross Cover Test (6 months - 3rd grade)				
E. Color Vision 4th grade males; others optional)				
F. Visual Acuity (as early as possible) **Screen:** R 10/___ L 10/___ **Rescreen:** R 10/___ L 10/___ R 10/___ L 10/___ R 10/___ L 10/___				
G. Optional Plus Lens (No Rx and WNL all other procedures) +2.25 (1st-3rd grades) +1.75 (4th grade and up)				
H. Optional 4-Dot (Kindergarten - 3rd grade)				
I. Tracking I Binocular (until V.A.)				
J. Tracking II Monocular (until V.A.)				
K. Monocular Localization (until V.A.)				
L. Pupillary Light Response (until V.A.)				
M. Retinal Reflex (until V.A.)				

VISION HISTORY AND QUESTIONS - All Ages

	NO	YES
1. Do you suspect anything is wrong with your child's eye/vision?		
2. Have the child's siblings, parents grandparents, aunts, uncles, or first cousins had eye/vision problems that required treatment before entering school?		
3. Have you observed any problems or change in the whites, pupils, lids, lashes or the area around the eyes?		
4. Have your noticed an abnormal sensitivity to light, nausea or dizziness or signs/complaints of headaches?		
5. Have you notices any of the following?		
a. Turning of one eye (in, out, up or down)		
b. Poking at the eyes or frequent rubbing		
c. Poor eye contact		
d. Covering or closing an eye when looking at an item of interest		
e. Abnormal head posture		
f. Squinting		
g. Moving the head forward, backward or on the horizontal while looking at an item of interest.		
h. Tilting head to one side		
I. Placing head close to item of interest		
j. Excessive blinking		
k. Inaccurate reaching for item of interest		
l. Unusual tearing		

Audiogram

Name: _____ **Date:** _____ **By:** _____

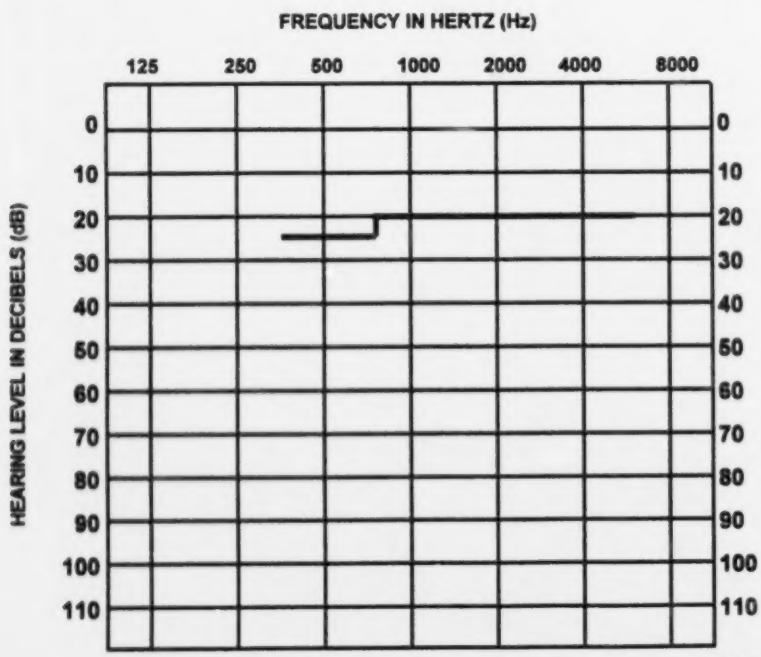


Attach Tympanogram here:

KEY	EAR	COLOR	AIR
	RIGHT	RED	O
	LEFT	BLUE	X

Audiogram

Name: _____ **Date:** _____ **By:** _____



Attach Tympanogram here:

KEY	EAR	COLOR	AIR
	RIGHT	RED	O
	LEFT	BLUE	X

Minnesota Department of Health
Hearing and Vision Conservation Districts

Donald Ogston
Government Service Center
Room 703
320 West 2nd Street
Duluth, MN 55802
(218) 723-4645

Roger Paquin
Minnesota Department of Health
717 Delaware St. S.E.
P.O. Box 9441
Minneapolis, MN 55440
(612) 623-5288

Janice Stenger
Minnesota Department of Health
Building 4A East Drive
Fergus Falls, MN 56537
(218) 739-7585

Pat Rice
Minnesota State Academy for the Deaf/HH
615 Olaf Hanson Drive
P.O. Box 308
Faribault, MN 55021-0308
(507) 332-5480

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